THE ROLE OF BIOLOGICAL DATA IN WATER QUALITY ASSESSMENT

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Abstract

Although the principal goal of the Water Quality Act is to restore and maintain chemical, physical, and biological integrity, the methods by which regulatory agencies have been attempting to achieve it are primarily chemical and toxicological. Difficulties with defining an ecological approach to assessing biotic integrity have probably led to this reliance on surrogate measures. One purpose of this volume is to define biotic integrity as a practical and workable concept upon which objective biological criteria can be based. Thus compliance with a major directive of the Water Quality Act can be measured directly. This also responds to a mandate of the Water Quality Act of 1987 for the development of biological monitoring and assessment methods as both a supplement and an alternative to the pollutant-by-pollutant criteria approach for toxic chemicals (Section 308).

This biocriteria approach can also be described as a systems approach in which the focus is on the resource (i.e., aquatic life) and its response to different environmental impacts. This approach permits a variety of different resource management options to be examined and used as a strategy to restore or protect the performance of the resource. In contrast, the current chemical specific/toxicity approach can be characterized as a regulatory approach in which the focus is on specific pollutants with specific rules for discharge being specified. This proposal advocates the complimentary use of both approaches, not one to the exclusion of the other.

The use of biological communities, particularly fish and macroinvertebrates, offers a holistic, systems approach to surface water quality assessment and management. Aquatic organisms not only integrate a variety of environmental influences (chemical, physical, and biological), but complete their life cycles in the water body and as such are continuous monitors of environmental quality. Focusing on major organism groups such as fish and macroinvertebrates represents biological evaluation at the sub-community level. This differs from past biological monitoring protocols which advocated the resource intensive monitoring of a variety of different organism groups (e.g., algae, macrophytes, zooplankton, diatoms, etc., in addition to fish or macroinvertebrates) at the same time. Another attractive feature of the biocriteria approach is that sampling need not be conducted under absolute worst case or critical conditions (i.e., $Q_{7,10}$ flow) to determine attainment/non-attainment of aquatic life uses. This certainly presents a powerful assessment tool compared to the steady state

approaches inherent to commonly applied chemical specific and toxicity methods. Including this type of biological field assessment along with traditional chemical and toxicity tools can significantly enhance decision making and regulatory resource allocation, particularly with complex issues.

The type of biological field assessments advocated by this document (i.e., sub-community level analysis) is cost competitive with chemical specific and toxicity testing methods. It is also equally cost effective when the power of the information derived from each is considered. The cost analysis presented in this document tends to refute the widely-held reputation of biological surveys as being prohibitively expensive.

Biological criteria were developed for Ohio rivers and streams using the biosurvey/ecoregion approach and the design of the Stream Regionalization Project in conjunction with the U.S. EPA Environmental Research Laboratory - Corvallis. A set of least impacted reference sites from across the state and within each of the five ecoregions of Ohio were carefully selected and sampled for fish and macroinvertebrates. These sites represent watersheds with the least disturbance from human activity within each ecoregion. Based on these results criteria for three biological indices, the Index of Biotic Integrity (IBI, based on fish), the Modified Index of Well-Being (I_{wb}, fish), and the Invertebrate Community Index (ICI, macroinvertebrates) were derived. This design satisfies the definition of biological integrity as the biological performance achieved by the natural habitats within a region.

Practical uses of this approach include determining appropriate and attainable aquatic life uses for surface waters, extending antidegradation concerns to nonpoint and habitat impacts, enhanced problem discovery for toxics, prioritizing the use of regulatory resources (e.g., permits, grants, 304(1) lists), and as a check on the attainment of Water Quality Act goals (e.g., 305(b) reporting).

Several examples from past Ohio EPA biological surveys are presented as a demonstration of how the biological criteria can be used and the complex combination of point source, nonpoint source, and habitat factors that are common to most study areas. The problem discovery capabilities of biological assessment are emphasized.

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